

Course Syllabus & Lesson Plan

Physiology for Medical Sciences-II (SCBM-262)

Credit Hour: 2 (2-0)

Academic Year: 2022
January 10 – March 2, 2023

**SCBM 262: Physiology for Medical Sciences-II
Academic Year 2022/2**

Course Title	Physiology for Medical Sciences-2
Course Code	SCBM-262
Course Credit	2 (2-0)
Prerequisite	SCBM-261

Course Description

Functions of the cardiovascular and respiratory systems, mechanisms of homeostatic regulation of circulation and respiration, common pathological examples; integration of these systems in responses to extrinsic factors such as exercise and hemorrhagic shock to maintain homeostasis

หน้าที่ของระบบหัวใจและหลอดเลือดและระบบหายใจ กลไกการควบคุมการทรงสภาพของการไหลเวียนและการหายใจ ตัวอย่างพยาธิสภาพที่พบบ่อย การประสานงานของระบบต่างๆ เพื่อตอบสนองต่อปัจจัยภายนอก ได้แก่ การออกกำลังกาย และภาวะช็อคจากการเสียเลือด เพื่อให้เกิดการทรงสภาพของร่างกาย

Course Objectives

After completing this course, students should be able to:

1. Explain functional principles, regulation, co-ordination and factors influencing on cardiovascular system
2. Explain functional principles, regulation, co-ordination and factors influencing on respiratory system
3. Discuss the abnormal conditions and indicate the causes affecting the functions of cardiovascular system and respiratory system
4. State the significance of physiology in diagnosis of diseases and treatment of patients

Course Overview:

Physiology for Medical Sciences-II is organized for undergraduate students in the programs related to medical science or biological science. The course provides the fundamental concepts and principles of cardiovascular and respiratory systems in the aspects of functional principles, regulation, coordination and controls. Response to environmental changes and some clinical examples will be introduced to encourage the critical understanding of conceptual information. Active participation of students will be emphasized in the class of formative evaluation.

Course Organization:**1. Lectures**

There are total of 31hr lectures (Cardiovascular System 14h, Respiratory System 12-h) to cover the concepts of the two systems.

2. Group Discussion Sessions

There are two group discussion sessions (2.5-hr for each session) The sessions involve examination and then discussion on question related to lectures. Individual discussion to conclude the best explanation for the answer are the main focus.

Teaching Media:

1. PowerPoint presentation
2. Text-books

Student Assessment:**1. Examinations:**

Examinations will be conducted twice in the end of the cardiovascular and respiratory lectures, respectively. The exam questions are multiple choices with 4 choices and/or the essay exam.

Exam I: Cardiovascular system	60	points	(30.0%)
Exam II: Respiratory system	60	points	(30.0 %)
SUM <u>140 points</u> (70% of Total)			

2. Assignment & Performance for Activities

The 10% of total weight of score has been set for individual work assignment. Another 10% of total weight of score has been set for presentation performance. The 20% of total weight of score has been set for two post-presentation quiz.

Student achievement will be graded according to the faculty and university standard using the symbols: A, B⁺, B, C⁺, C, D⁺, D, and F.

Recommended Textbooks:

1. Koeppen B.M. and Stanton B.A. (2008) *Berne & Levy Physiology*, 6th ed, MOSBY Elsevier, Philadelphia, PA, USA.
2. Boron W.F. and Boulpaep E.L. (2005) *Medical Physiology: A cellular and Molecular Approach*, Updated Edition, Elsevier Saunders, Philadelphia, PA, USA.
3. Levitzky MG. (2003) *Pulmonary Physiology*. 6th ed. New York McGraw-Hill, USA.
4. West JB. (2005) *Respiratory Physiology: The essentials*. 7th ed. Philadelphia: Lippincott Williams & Wilkins, USA.

Course Management: Online and Onsite

Course Coordinator:

Assoc. Prof. Tepmanas Bupha-Intr, Ph.D. Room: B-508
 Tel: 0-2201-5610 E-mail: tepmanas.bup@mahidol.ac.th

Lecturers:**Dept. of Physiology, Faculty of Science:**

	<u>Room</u>	<u>Phone No.</u>
Assoc. Prof. Tepmanas Bupha-Intr, Ph.D.	PR-403	0-2201-5625
Assist. Prof. Dr. Nattapon Panupinthu, M.D.	B506	0-2201-5610
Metaneeya Pilanthananond, PhD	B506	0-2201-5610

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Physiology for Medical Sciences 2 (SCBM 262)
2 credits (2-0-4)
Academic Year 2023 Semester 2

Day	Date	Time	Topics	h	Lecturers
1	Tue Jan 10	09.00–09.30	Course orientation	0.5	Tepmanas
		09.30–11.00	Introduction to the cardiovascular system	1.5	Tepmanas
2	Thu Jan 12	09.00–10.30	Electrophysiology of the heart	1.5	Tepmanas
		10.30–12.00	Electrocardiogram	1.5	Tepmanas
3	Tue Jan 17	09.00-10.00	Hemodynamics	1.0	Tepmanas
		10.00-11.30	Cardiodynamics	1.5	Tepmanas
4	Thu Jan 19	09.00-10.00	Common heart diseases	1.0	Tepmanas
		10.00-11.00	Arterial physiology & Blood pressure	1.0	Tepmanas
		11.00-12.00	Capillary & Venous circulation	1.0	Tepmanas
5	Tue Jan 24	09.00–11.30	Discussion in heart rate monitor and arterial blood pressure measurement	2.5	Metaneeya /Tepmanas
6	Thu Jan 26	9.00-11.00	Vasomotor controls	2.0	Tepmanas
7	Tue Jan 31	09.00–11.00	Common vascular diseases	1.5	Tepmanas
Formative Evaluation On-Line: January 31, 2023 by 13.00					
8	Thu Feb 2	09.00–12.00	EXAM I: Cardiovascular system	3.0	Tepmanas
9	Tue Feb 7	09.00–10.00	Introduction to respiratory system	1	Tepmanas
		10.00-11.00	Mechanics of breathing part I	1	Tepmanas
10	Thu Feb 9	09.00–10.00	Mechanics of breathing part II	2	Tepmanas
11	Tue Feb 14	09.00–11.00	Gas transfer process	2	Nattapon
12	Thu Feb 16	09.00–11.00	Lung ventilation and pulmonary blood flow	2	Nattapon
13	Tue Feb 21	09.00-10.00	Control of breathing	1	Tepmanas
		10.00-11.00	Cardio-Respiratory response during exercise	1	Tepmanas
14	Thu Feb 23	09.00-11.30	Discussion: Lung function test	2.5	Metaneeya/ Tepmanas
15	Tue Feb 28	09.00-10.00	Common lung diseases	1	Tepmanas
		10.00-11.00	COVID 19: Respiratory complication	1	Tepmanas
16	Thu Feb 24	09.00-09.30	Formative evaluation	0.5	Self-evaluate
Mar 2	EXAM II: Respiratory system (09.00 AM – 12.00 PM)				
Total hour (Exclude Orientation, Self-study, Exam and Formative Evaluation)				30.5	hours

LESSON PLAN OF THE COURSE

Lecture 1: Introduction to the Cardiovascular System

Lecturer: Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology

Date/Time: January 10, 2023/ 09.30-11.00

Learning Objectives:

Students should be able to:

1. Explain the role of cardiovascular system in maintaining body homeostasis.
2. Discuss the structure-function relations of the circulatory system.
3. Discuss the arrangements of organ systems and the operating concept of cardiovascular system to achieve its main objective.
4. Explain the operating circuit in controlling cardiovascular function.
5. Explain the process of excitation-contraction coupling of cardiomyocytes.
6. Discuss the factors that affect the mobilization of intracellular calcium in cardiomyocytes.

Content Outline:

1. Significance of the cardiovascular system in body homeostasis.
2. The structure-function relations of the circulatory system.
3. Cardiac muscle activity
4. Cardiovascular control
5. Blood

Learning Organization:

1. Lecture 70 min.
2. Clip video on blood 10 min.
3. Question and answer 10 min.

Learning Materials:

1. Transcript of lecture objectives and outline
2. Lecture presentation
3. Video clip on blood.

References:

1. Koeppen B.M. and Stanton B.A. (2008) *Berne & Levy Physiology*, 6th edition, Chapter 15: Overview of Circulation, pp.289-291, MOSBY Elsevier, Philadelphia, PA, USA.

Student Assessment: MCQ and/or Written Exam

Lecture 2: Electrophysiology of the Heart**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology.**Date/Time:** January 12, 2023/ 09.00-10.30**Learning Objectives:**

Students should be able to:

1. Identify the components and propagation pathway of cardiac electrical signals
2. Explain the ionic basis of cardiac resting membrane potential, fast response action potential, and slow response action potential
3. Describe the mechanism and significance of action potential duration, diastolic depolarization, refractory periods, and conduction velocity
4. Describe the sequence of activation of the heart and indicate the importance of timing of the various events to efficient function

Content Outline:

1. Cardiac resting membrane potentials
2. Cardiac cell action potentials
3. Propagation pathway of cardiac action potentials
4. Cardiac excitability
5. Conduction velocity
6. Physiological changes in action potentials of the heart

Learning Organization:

1. Study the suggested reading materials in advance
2. A sessions of 60-min lecture
3. A session of Video presentation 15 min
4. A session of 10-min class discussion

Learning Materials:

1. Transcripts of lecture outline
2. PowerPoint lecture presentation
3. Video clip

References:

1. Koeppen B.M. and Stanton B.A. (2008) *Berne & Levy Physiology*, 6th edition, Chapter 16: Elements of Cardiac Funstion, pp.292-317, MOSBY Elsevier, Philadelphia, PA, USA.
2. Levick JR. *An Introduction to Cardiovascular Physiology*, 4th ed. Arnold, London, 2003.
3. Mohrman DE and Heller LJ. *Cardiovascular Physiology*, 5th ed. McGraw Hill, 2003.

Student Assessment: MCQ and/or Written Exam

Lecture 3: Electrocardiogram**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology**Date/Time:** January 6, 2023/ 10.30-12.00**Learning Objectives:**

Students should be able to:

1. Describe the principle of dipole and apply the dipole principle for ECG recording
2. Draw a typical ECG record labeling the waves and indicate the timing of the electrical activation of cells following the sequence of activation of the heart
3. Indicate the ECG conventions of leads I, II and III as well as determine the mean electrical axis of a heart

Contents Outline:

1. Principles of Electrocardiography
2. Vectors and the sequence of activation
3. Electrodes and recording leads
4. Recording the dipole in a specific lead
5. ECG, the conduction system, and timing

Learning Organization:

1. Study the suggested reading materials in advance
2. A session of 60-min lecture
3. A session of Video presentation 20 min
4. A session of 10-min class discussion

Learning Materials:

- 1 Transcripts of lecture outline.
- 2 PowerPoint lecture presentation.
- 3 Clip video.

References:

1. Boron WF and Boulpaep EL. Medical Physiology. Updated ed. Philadelphia: Elsevier, 2005.
2. Guyton AC and Hall JE. Textbook of Medical Physiology. 11th ed. Philadelphia: Elsevier Saunders, 2006.

Student Assessment: MCQ and/or Written Exam

Lecture 4: Hemodynamics**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology**Date/Time:** January 17, 2030 / 9.00-10.00**Learning Objectives:**

Students should be able to:

1. Discuss the relationship between pressure gradient, fluid flow, and resistance to flow
2. Describe factors determining the blood flow in terms of the Poiseuille's equation
3. Describe the pressure changes that occur as blood flows through a simple vascular network and relate them to the vascular resistance of the various vascular segments

Content Outline:

1. Blood flow
 - a. Pressure gradient and resistance
 - b. Poiseuille's equation
 - c. Fahraeus-Linqvist effect
 - d. Reynold's number
2. Bernoulli's principle
3. Elastic properties of blood vessel
 - a. Compliance
 - b. Wall tension

Learning Organization:

1. Study the suggested reading materials in advance
2. A session of 50-min lecture
3. A session of 10-min class discussion

Learning Materials:

1. Transcripts of lecture objectives and outline
2. PowerPoint lecture presentation

References:

1. Guyton AC and Hall JE. Textbook of Medical Physiology. 11th ed. Philadelphia: Elsevier Saunders, 2006.
2. Levick JR. An Introduction to Cardiovascular Physiology 4th ed. Arnold, London, 2003.

Student Assessment: MCQ and/or Written Exam

Lecture 6: Cardiodynamics and Cardiac Pump**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology**Date/Time:** January 17, 2023 /10.00-11.30**Learning Objectives:**

Students should be able to:

1. Define the cardiac cycle and describe its events
2. Explain the contractile events underlying pressure generation
3. Discuss the determinants of stroke volume and their effects on cardiac output
4. Discuss the determinants of heart rate and their effects on cardiac output
5. Explain the generation and alterations of the cardiac function curve

Content Outline:

1. Structure of the heart in relation to function
 - 1.1 Cardiac chambers and valves
 - 1.2 Myocardial cell
 - a) Frank-Starling relationship
 - b) Excitation-contraction coupling
 - c) Myocardial contractile machinery and contractility
 - d) Heart sounds
2. Cardiac pump cycle
 - 2.1 The cardiac volumes and dynamics
 - 2.2 The cardiac cycle in terms of ventricular volume-pressure relationship
 - a) Volume-pressure relation during a "beat" of the heart
 - b) Heterometric autoregulation
 - c) Homeometric regulation
 - 2.3 Regulation of cardiac output
 - 2.4 The cardiac function curve or so called Starling curve
 - a) Generation of the cardiac function curve
 - b) Alterations in Starling (cardiac function) curves
 - 2.5 Subcellular mechanism for regulation of cardiac function

Learning Organization:

1. Study the suggested reading materials in advance
2. A session of 60-min lecture
3. A session of Video presentation 20 min
4. A session of 10-min class discussion

Learning Materials:

1. Transcript of lecture objectives and outline
2. Textbooks and references
3. PowerPoint presentation of the lecture

References:

1. Koeppen B.M. and Stanton B.A. (2008) *Berne & Levy Physiology*, 6th edition, Chapter 16: Elements of Cardiac Function, pp. 317-329, MOSBY Elsevier, Philadelphia, PA, USA.
2. Levy M.N., Koeppen B.M., and Stanton B.A. (2006) *Berne & Levy Principles of Physiology*, 4th edition, Chapter 18: Cardiac Pump, pp. 245-259, MOSBY Elsevier, Philadelphia, PA, USA.
3. Rhoades R.A. and Tanner G.A. (2004) *Medical Physiology*, 2nd edition, Chapter 14: The Cardiac Pump, pp. 237-251, Lippencott Williams & Wilkins, Baltimore, MD, USA.

Student Assessment: MCQ and/or Written Exam

Lecture 7: Common Heart Diseases**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology**Date/Time:** January 19, 2023/ 09.00-10.00**Learning Objectives:**

Students should be able to:

1. Explain the cause of heart failure and the cardiovascular compensation.
2. Discuss the effect of valvular diseases on arterial blood pressure and cardiac output.
3. Discuss the consequent effect and response to heart problem.

Content Outline:

1. Systolic and Diastolic heart failure
2. Valvular disorders
3. Body response to heart failure

Learning Organization:

1. Study the learning materials provided in advance
2. 50-min lecture by video presentation
3. 10- min discussion

Learning Materials:

1. Transcript of lecture outline
2. Clip video of lecture presentation

References:

1. Boron WF and Boulpaep EL. Medical Physiology. Updated ed. Philadelphia: Elsevier, 2005.
2. Laughlin MH Cardiovascular Response to Exercise. *Am. J. Physiol.* 277 (*Adv. Physiol. Educ.* 22): S244–S259, 1999.
3. Opie LH. Heart Physiology: From cell to circulation. 4th ed. Philadelphia: Lippincott Williams & Wilkins, 2004.

Student Assessment: MCQ and/or Written Exam

Lecture 8: Arterial Physiology & Blood pressure**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology**Date/Time:** January 19, 2023/ 10.00-11.00**Learning Objectives:**

Students should be able to:

1. Discuss the basic relationships between cardiac output, systemic arterial pressure, and total peripheral resistance to the flow of blood
2. Discuss the relationships between stroke volume, heart rate, systemic vascular resistance, mean arterial pressure, pulse pressure, and vascular compliance

Content Outline:

1. The pressure and pressure gradients generation.
2. Arterial elasticity and determinants of the arterial blood pressure
3. Factor affecting arterial blood flow (Coronary artery as example)

Learning Organization:

1. Study the learning materials provided in advance
2. Lecture 50 min.
3. 10 min of discussion

Learning Materials:

1. Transcript of lecture objectives and outline
2. Textbooks and References
3. PowerPoint presentation of the lecture

References:

1. Koeppen B.M. and Stanton B.A. (2008) *Berne & Levy Physiology*, 6th edition, Chapter 17: Properties of the Vasculature, pp. 336-342, MOSBY Elsevier, Philadelphia, PA, USA.
2. Levy M.N., Koeppen B.M., and Stanton B.A. (2006) *Berne & Levy Principles of Physiology*, 4th edition, Chapter 21: Arterial System & Chapter 23: Peripheral Circulation and Its Control, pp. 288-297 and pp. 309-319, MOSBY Elsevier, Philadelphia, PA, USA.
3. Rhoades R.A. and Tanner G.A. (2004) *Medical Physiology*, 2nd edition, Chapter 15: The Systemic Circulation, pp. 252-261, Lippencott Williams & Wilkins, Baltimore, MD, USA.

Student Assessment: MCQ and/or Written Exam

Lecture 9: Capillary & Venous Circulation
Lecturer: Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology
Date/Time: January 19, 2023/ 11.00-12.00

Learning Objectives:

Students should be able to:

1. Describe the significance of capillary network on capillary flow
2. Discuss the physical factors governing fluid movement across the capillary membrane
3. Discuss the vasoactive substances generated from endothelial cells
4. Describe the function of the venous system as the blood reservoir

Content Outline:

1. Capillary network and transcapillary exchange
2. Other functions of the endothelial lining
3. Angiogenesis
4. Basic features of the venous system
5. Factors that alter venous pressure and venous return

Learning Organization:

1. Study the learning materials provided in advance
2. Lecture 50 min.
3. Questions and answers 10 min.

Learning Materials:

1. Transcript of lecture objectives and outline
2. Textbooks and References
3. PowerPoint presentation of the lecture

References:

1. Koeppen B.M. and Stanton B.A. (2008) *Berne & Levy Physiology*, 6th edition, Chapter 17: Properties of the Vasculature, pp. 336-342, MOSBY Elsevier, Philadelphia, PA, USA.
2. Levy M.N., Koeppen B.M., and Stanton B.A. (2006) *Berne & Levy Principles of Physiology*, 4th edition, Chapter 21: Arterial System & Chapter 23: Peripheral Circulation and Its Control, pp. 288-297 and pp. 309-319, MOSBY Elsevier, Philadelphia, PA, USA.
3. Rhoades R.A. and Tanner G.A. (2004) *Medical Physiology*, 2nd edition, Chapter 15: The Systemic Circulation, pp. 252-261, Lippencott Williams & Wilkins, Baltimore, MD, USA.

Student Assessment: MCQ and/or Written Exam

Lecture 10: Heart Rate Monitor and Blood Pressure measurement

Lecturer: Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology
Metaneeya Pилanthanonnd. Department of Physiology

Date/Time: January 24, 2023/ 09.00-11.30

Learning Objectives:

Students should be able to:

1. Descript the technique to monitor heart rate and pulse rate
2. Discuss factors that affect the accuracy on heart rate monitor.
3. Descript the principle of non-invasive measurement of blood pressure.
4. Discuss factors affecting the accuracy on blood pressure measurement

Content Outline:

1. Heart rate/pulse rate monitor
2. Blood pressure measurement

Learning Organization:

1. Self-study on assigned question
2. Student presentation and discussion 120 min.
3. Post-discussion examination 30 min.

Learning Materials:

1. Transcript of lecture outline
2. Assigned question

References:

1. Boron WF and Boulpaep EL. Medical Physiology. Updated ed. Philadelphia: Elsevier, 2005.
2. Laughlin MH Cardiovascular Response to Exercise. *Am. J. Physiol.* 277 (*Adv. Physiol. Educ.* 22): S244–S259, 1999.
3. Opie LH. Heart Physiology: From cell to circulation. 4th ed. Philadelphia: Lippincott Williams & Wilkins, 2004.

Student Assessment: MCQ and/or Written Exam

Lecture 11: Vasomotion Controls**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology**Date/Time:** January 26, 2023/ 09.00-11.00**Learning objectives:**

Students should be able to:

1. Explain factors involved in the cardiovascular control system
2. Describe the role of autonomic (sympathetic and parasympathetic) outflow in controlling cardiovascular system
3. Discuss the functions of the baroreceptors and chemoreceptors in the cardiovascular control system
4. Discuss the involvements of humoral and physical factors in cardiovascular control

Content outline:

1. Factors involved in cardiovascular control
 - 1.1 Extrinsic control
 - a) Neural influences on circulatory control
 - b) Humoral factors
 - 1.2 Intrinsic or local control
 - a) Myogenic regulation
 - b) Endothelial-mediated regulation
 - c) Metabolic regulation
2. Coupling between the heart and the blood vessels
3. How does the cardiovascular control operate?

Learning Organization:

1. Studying the learning materials provided in advance
2. two sessions of 50 min lecture.
3. Questions and answers 2 x 10 min.
4. Self study

Learning Materials:

1. Transcripts of lecture objectives and outline
2. Textbooks and References
3. PowerPoint presentation of the lecture

References:

1. Koeppen B.M. and Stanton B.A. (2008) *Berne & Levy Physiology*, 6th edition, Chapter 18: Regulation of the Heart and Vasculature, pp. 370-392, and Chapter 19: Integrated Control of the Cardiovascular System, pp. 393-414, MOSBY Elsevier, Philadelphia, PA, USA.
2. Levy M.N., Koeppen B.M., and Stanton B.A. (2006) *Berne & Levy Principles of Physiology*, 4th edition, Chapter 23: Peripheral Circulation and Its Control, pp. 309-318, Chapter 24: Control of Cardiac Output: Coupling of the Heart and Blood Vessels, pp. 320-332, and Chapter 26: Interplay of Central and Peripheral Factors in control of the Circulation, pp. 346-360, MOSBY Elsevier, Philadelphia, PA, USA.
3. Rhoades R.A. and Tanner G.A. (2004) *Medical Physiology*, 2nd edition, Chapter 18: Control Mechanisms in Circulatory Function, pp. 290-308, Lippencott Williams & Wilkins, Baltimore, MD, USA.

Student Assessment: MCQ and/or Written Exam

Lecture 12: Common vascular disease**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology**Date/Time:** January 31, 2023/ 09.00-10.30**Learning Objectives:**

Students should be able to:

1. State the criteria of hypertension, sign and symptom and risk factor.
2. Discuss the pathophysiology of atherosclerosis
3. Discuss the pathophysiology of varicose vein

Content Outline:

1. Hypertension
 - Sign and symptom
 - Risk factor
 - Treatment and prevention
2. Atherosclerosis
 - Cellular pathophysiology
 - Risk factor and treatment
3. Varicose vein

Learning Organization:

1. Study the learning materials provided in advance
2. Lecture 50 min.
3. Questions and answers 10 min.
4. Self-study

Learning Materials:

1. Transcript of lecture outline
2. Clip video of lecture presentation

References:

1. Boron WF and Boulpaep EL. Medical Physiology. Updated ed. Philadelphia: Elsevier, 2005.
2. Laughlin MH Cardiovascular Response to Exercise. *Am. J. Physiol.* 277 (*Adv. Physiol. Educ.* 22): S244–S259, 1999.
3. Opie LH. Heart Physiology: From cell to circulation. 4th ed. Philadelphia: Lippincott Williams & Wilkins, 2004.

Student Assessment: MCQ and/or Written Exam

Lecture 13: Introduction to the Respiratory System**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology**Date/Time:** February 7, 2023/ 09.00-10.00**Learning Objectives:**

Students should be able to

1. Discuss structure and function of upper and lower airways.
2. Outline the sequential steps of gas transfer between the cells and the external environment
3. Understand the basic physical principles that govern the process of gas transfer in the respiratory physiology

Lecture Outline:

1. Structural organization of the respiratory system
2. Cells of the airways.
3. Steps of gas transfer between the cells and the external environment
4. Physical principles of gases

Learning Organization:

1. Studying the learning materials provided in advance
2. Lecture 50 min
3. Questions and answers 10 min
4. Self study

Learning Materials:

1. Transcripts of PowerPoint presentation

References:

1. Levitzky MG. Pulmonary Physiology, 5th ed. New York: McGraw-Hill, 1999.
2. West JB. Respiratory Physiology – The essential, 6th ed. Baltimore: Williams & Wilkins, 2000.
3. Koeppen BM and Stanton BA. Berne & Levy Physiology 6th ed. Mosby & Elsevier, 2007.

Student Assessment: MCQ and/or Written Exam

Lecture 14: Mechanics of Breathing I & II

Instructor: Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology

Date/Time: February 7, 2023/ 10.00-11.00
February 9, 2023/ 09.00-10.30

Learning Objectives:

Students should be able to:

1. Describe the mechanical events associated with breathing.
2. Describe the physical factors influencing pulmonary ventilation.
3. Explain the relative roles of the respiratory muscles and lung elasticity in effecting lung volumes.
4. Discuss the role of surfactant and its physiological significant
5. Define airways resistance and list factors that alter the resistance to airflow.
6. Distinguish between the restrictive and obstructive lung diseases including the spirometric abnormality and work of breathing associated with each category

Lecture Outline:

1. Pulmonary ventilation
 - Inspiration
 - Expiration
2. Lung volumes and capacities
3. Lung compliance
4. Airway resistance
5. The work of breathing

Learning Organization:

1. Studying the learning materials provided in advance
2. Two sessions of lecture (50 and 80 min)
3. Questions and answers 2 x 10 min
4. Self study

Learning Materials:

1. Transcripts of lecture outline
2. PowerPoint presentation/handout

References:

1. Koeppen BM, Stanton BA. Berne & Levy Physiology, 6th ed. Philadelphia: Mosby, 2008.
2. Levitzky MG. Pulmonary Physiology, 6th ed. New York: McGraw-Hill, 2003.
3. West JB. Respiratory Physiology – The essential, 7th ed. Baltimore: Williams & Wilkins, 2005.

Student Assessment: MCQ and/or Written Exam

Lecture 15: Gas Transfer Process

Lecturer: Assist. Prof. Dr. Nattapon Panupinthu. Department of Physiology

Date/Time: February 14, 2023/ 09.00-11.00

Learning objectives:

Students should be able to

1. Discuss structure and function of upper and lower airways.
2. Outline the sequential steps of gas transfer between the cells and the external environment
3. Understand the basic physical principles that govern the process of gas transfer in the respiratory physiology

Lecture outline:

1. Structural organization of the respiratory system
2. Cells of the airways.
3. Steps of gas transfer between the cells and the external environment
4. Physical principles of gases

Learning organization:

1. Studying the learning materials provided in advance
2. Two sessions of 50 min lecture
3. Questions and answers 2 x 10 min
4. Self study

Learning materials:

1. Transcripts of PowerPoint presentation

References:

1. Levitzky MG. Pulmonary Physiology, 5thed. New York: McGraw-Hill, 1999.
2. West JB. Respiratory Physiology – The essential, 6th ed. Baltimore: Williams & Wilkins, 2000.
3. Koeppen BM and Stanton BA. Berne & Levy Physiology 6th ed. Mosby & Elsevier, 2007.

Student Assessment: MCQ and/or Written Exam

Lecture 16: Lung Ventilation and Pulmonary Blood Flow**Lecturer:** Assist. Prof. Dr. Nattapon Panupinthu, Department of Physiology**Date/Time:** February 16, 2023/ 09.00-11.00**Learning Objectives**

The students should be able to:

1. Distinguish anatomical and physiological dead space.
2. Discuss the role of dead space in governing partial pressure of alveolar gases.
3. Describe the effect of hypo- and hyperventilation on alveolar gas tension.
4. Describe the factors causing non-uniform distribution of ventilation in the lungs.
5. Compare the physiological characteristics between pulmonary circulation and systemic circulation.
6. List factors influencing pulmonary vascular resistance.
7. Discuss how distribution of blood flow is not uniformed throughout the lungs.

Content Outlines

1. Pulmonary ventilation
 - Minute ventilation, dead space, and alveolar ventilation
 - Effects of ventilation on alveolar gases.
 - Regional distribution of inspired gas in the lungs
2. Pulmonary circulation
 - Physiological characteristics
 - Pulmonary vascular resistance
 - Regional distribution of pulmonary blood flow

Learning Organization

1. Studying the learning materials provided in advance.
2. Two sessions of 50 min lecture.
3. Questions and answer 2 x 10 min.
4. Self study.

Learning Materials

1. Transcripts of lecture outline.
2. Slides from PowerPoint lecture presentation.

References:

1. Koeppen BM, Stanton BA. (2008) Berne & Levy Physiology, 6th ed. Philadelphia: Mosby. Sec 4, Ch 22.
2. Levitzky MG. (2003) Pulmonary Physiology. 6th Ed. New York McGraw-Hill.
3. Rhoades RA, Bull DR. (2013) Medical physiology: Principles for Clinical Medicine, 4th ed. Philadelphia: Wolter Kluwer/ Lippincott Williams & Wilkins. Ch 18.
4. Sherwood L. (2001) Human Physiology: From cells to systems. 4th ed. California: Brooks/Cole.
5. West JB. (2005) Respiratory Physiology: The essentials. 7th ed. Philadelphia: Lippincott Williams & Wilkins.

Student Assessment: MCQ and/or Written Exam

Lecture 17: Control of Breathing**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology**Date/Time:** February 21, 2023/ 09.00-10.00**Learning Objectives:**

Students should be able to:

1. Identify the groups and function of neurons that are thought to play a role in the regulation of breathing.
2. Give two examples of reflexes involving pulmonary receptors that influence pattern of breathing.
3. Identify the location of chemoreceptors in the respiratory system.
4. Describe the effects of changes in the partial pressure of oxygen, carbon dioxide, and hydrogen ion level on the control of breathing.
5. Describe the role of respiratory system in acid-base regulation.

Lecture Outline:

1. Neural control of breathing
 - 1.1 Generation of spontaneous respiratory pattern
 - 1.2 Medullary respiratory center
 - 1.3 The pons respiratory center
 - 1.4 Reflexes control of respiration
2. Chemical control of breathing
 - 2.1 The peripheral arterial chemoreceptor
 - 2.2 The central chemoreceptor
3. Acid-base regulation

Learning Organization:

1. Studying the learning materials provided in advance
2. Lecture 50 min
3. Questions and answers 10 min
4. Self study

Learning Materials:

1. Transcript of lecture outline
2. Clip video of lecture presentation

References:

1. Koeppen BM, Stanton BA. Berne & Levy Physiology, 6th ed. Philadelphia: Mosby, 2008.
2. Levitzky MG. Pulmonary Physiology, 6th ed. New York: McGraw-Hill, 2003.
3. West JB. Respiratory Physiology – The essential, 7th ed. Baltimore: Williams & Wilkins, 2005.

Student Assessment: MCQ and/or Written Exam

Lecture 18: Cardio-respiratory response during exercise**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology**Date/Time:** February 21, 2023/ 10.00-11.00**Learning Objectives:**

Students should be able to:

1. Explain the sensory inputs that stimulate the cardiac & respiratory center during exercise.
2. Explain the relationship between exercise intensity and changes in cardiorespiratory function.
3. Discuss the effect of exercise training on cardio-respiratory adaptation.
4. Describe the breathing exercise technique

Lecture Outline:

1. Sensory input during exercise
2. Ventilatory threshold
3. Respiratory adaptation after aerobic training
4. Breathing exercise

Learning Organization:

1. Studying the learning materials provided in advance
2. Lecture 30 min
3. Video presentation 20 min
4. Questions and answers 10 min
5. Self study

Learning Materials:

1. Transcript of lecture outline
2. Clip video of lecture presentation

References:

1. Koeppen BM, Stanton BA. Berne & Levy Physiology, 6th ed. Philadelphia: Mosby, 2008.
2. Levitzky MG. Pulmonary Physiology, 6th ed. New York: McGraw-Hill, 2003.
3. West JB. Respiratory Physiology – The essential, 7th ed. Baltimore: Williams & Wilkins, 2005.

Student Assessment: MCQ and/or Written Exam

Lecture 19: Discussion: Lung function test

Lecturer: Metaneeya Pилanthananond, Department of Physiology
Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology

Date/Time: February 23, 2023/ 09.00-11.30

Learning Objectives:

Students should be able to:

1. Explain the objectives and principles of lung function test
2. Discuss the effect of lung compliance and airway resistance on lung functions
3. Discuss alternative technique to predict the lung function

Lecture Outline:

1. Minute ventilation and total lung volume
2. Forced expiratory function
3. Flow-Volume loop

Learning Organization:

1. Studying the learning materials provided in advance
2. Student presentation 120 min
3. Post discussion examination 30 min
4. Self study

Learning Materials:

1. Transcript of lecture outline
2. Clip video of lecture presentation

References:

1. Koeppen BM, Stanton BA. Berne & Levy Physiology, 6th ed. Philadelphia: Mosby, 2008.
2. Levitzky MG. Pulmonary Physiology, 6th ed. New York: McGraw-Hill, 2003.
3. West JB. Respiratory Physiology – The essential, 7th ed. Baltimore: Williams & Wilkins, 2005.

Student Assessment: MCQ and/or Written Exam

Lecture 20: Common lung diseases**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology**Date/Time:** February 28, 2023/ 09.00-10.00**Learning Objectives:**

Students should be able to:

1. Discuss common pathophysiology leading to hypoventilation
2. Discuss common pathophysiology leading to lung diffusion defect
3. Discuss common pathophysiology leading to ventilation-perfusion mismatch

Lecture Outline:

1. Lung fibrosis and emphysema
2. Asthmatic attack
3. Pneumothorax
4. Pulmonary edema
5. Pulmonary embolism

Learning Organization:

1. Studying the learning materials provided in advance
2. Lecture 50 min
3. Questions and answers 10 min
4. Self study

Learning Materials:

1. Transcript of lecture outline
2. Clip video of lecture presentation

References:

1. Koeppen BM, Stanton BA. Berne & Levy Physiology, 6th ed. Philadelphia: Mosby, 2008.
2. Levitzky MG. Pulmonary Physiology, 6th ed. New York: McGraw-Hill, 2003.
3. West JB. Respiratory Physiology – The essential, 7th ed. Baltimore: Williams & Wilkins, 2005.

Student Assessment: MCQ and/or Written Exam

Lecture 21: COVID 19: Respiratory complication**Lecturer:** Assoc. Prof. Tepmanas Bupha-Intr. Department of Physiology**Date/Time:** February 28, 2023/ 10.00-11.00**Learning Objectives:**

Students should be able to:

1. Explain the size effect of particle on respiratory infestation.
2. Discuss the respiratory transmission on SARS-CoV-2 virus.
3. Discuss the pathophysiology of SARS-CoV-2 virus on lung function.

Lecture Outline:

1. Air flow and particle deposition on airways.
2. SARS-CoV-2 virus particle and transmission
3. Lung pathology in patient with SARS-CoV-2 virus infection.

Learning Organization

1. Studying the learning materials provided in advance.
2. Lecture 30 min
3. Video presentation 10 min
4. Questions and answer 10 min
5. Self study.

Learning Materials

1. Transcripts of lecture outline.
2. Slides from PowerPoint lecture presentation.

References:

1. Heyder, J. Deposition of Inhaled Particles in the Human Respiratory Tract and Consequences for Regional Targeting in Respiratory Drug Delivery. Proceedings of the American Thoracic Society, 2004; 1:315-320
2. Rissler et. al. Deposition efficiency of inhaled particles (15-5000 nm) related to breathing pattern and lung function: an experimental study in healthy children and adults. Particle and Fibre Toxicology, 2017;14:10.
3. Yuki, Fujiogi, Koutsogioannaki,. COVID-19 pathophysiology: A review. Clin Immunol. 2020; 215:108427.

Student Assessment: MCQ and/or Written Exam